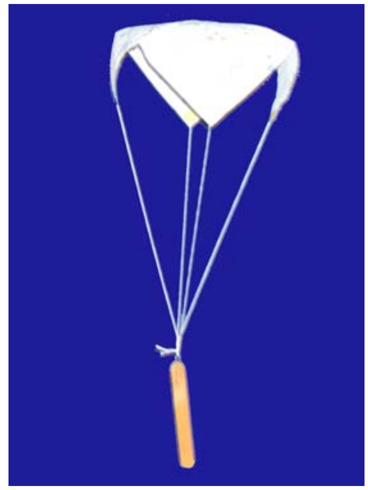
PARACHUTES

Lesson Plan: Parachutes: Is It Surface Area or Shape?



Grade level: 6-7

Subject Area: Science and Math

Time Required: Preparation: 30 minutes
Activity: 3-4 hours

National Standards Correlation:

Science (grades 5-8)

- Science as Inquiry Standard: Abilities necessary to do science inquiry.
- Physical Science Standard: Motion and forces.
- History and Nature Science Standard: Nature of science.
- Science and Technology Standard: Understanding about science and technology.

Math (grades 6-8)

- Measurement Standard: Apply appropriate techniques, tools, and formulas to determine measurements.
- Data Analysis and Probability Standard: Select and use appropriate statistical methods to analyze data.

Summary:

In small groups, students will investigate how the surface area and shape of a parachute affects its descent. Students will construct parachutes of different shapes containing the same surface area, drop them, and measure their time of descent. Students will also construct several parachutes of the same shapes but different surface areas, drop them, and measure their time of descent. Data will be collected in chart form and then graphed. The charts and graphs will be used to make inferences about the surface area and shape of parachutes and their time of descent.

Objectives:

Students will:

- Work in small groups to construct parachutes
- Measure the area of various geometric shapes
- Measure time of descent
- Collect data, create charts, and graph data
- Use data to make inferences about the surface area and shape of parachutes and the time of descent.

Background:

For science concepts, see the Introduction. The formulas for various geometric shapes are as follows:

Circle - Area = $\pi(r)(r)$, where r = radius
Square, rectangle, parallelogram - Area = $(b)(h)$, where b = base, and h = height
Triangle – Area = $\frac{1}{2}(b)(h)$, where b = base, and h = height
Trapezoid – Area = $\frac{1}{2}(h)(a + b)$, where a and b are the parallel sides

Materials:

Per group:

- Several sheets of paper of the same size

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Dayton, Ohio: The National Museum of the United States Air Force and The Air Force Museum Foundation, Inc. 1997-1999.

- Pencils, colored markers or pencils
- Paper to construct tables
- Graph paper
- Scissors
- String
- Reinforcement labels, adhesive dots or tape
- Rulers
- Stopwatch or watch with second hand
- Handful of large metal paper clips
- Large plastic garbage bags

Safety Instructions:

Caution students to not put plastic bags over faces and to not stand on tables to drop the parachutes.

Procedure:

A. Warm-up

1. Using several pieces of the same size paper, crumple one into a ball. As one student drops the ball, another times its descent, and a third observes its motion.

2. Drop another piece of paper flat without crumpling it. Observe it and time its descent.

3. This time crumple the piece of paper and then smooth it out before dropping it. Time it and observe its motion.

4. Next, ask students to discuss their observations and compare the times of descent. List inferences that can be made.

5. Ask these questions to guide the discussion:
- Which piece of paper would have made the most effective parachute? Why?
- Which do you predict would have more effect on the descent of a parachute – surface area or shape? Why?

B. Activity – Part One

1. Have each group of students measure and cut several different shapes of the same area out of the plastic garbage bags. Suggested shapes include: square, rectangle, trapezoid, parallelogram, triangle, and circle. The circle will be very challenging.

2. Cut 4 pieces of string, each the same length, for each shape. It is important that all the string used is the same length, so that the shape of the parachute is the only variable.

3. Attach the four pieces of string equidistant around the edge of each shape with the labels or tape.

4. Gather up the loose ends of the strings, being careful not to tangle them and tie together with a small loop, or fasten with another label.

5. Attach one of the large metal paper clips to each of the loops. The plastic part of the finished parachute is called the canopy, and the strings the shroud.

6. Drop each finished parachute several times from the same height. Observe the motion of each parachute as it falls and measure the time of its descent.

7. Develop a data table to record results. Then compute the average descent time for each canopy shape and record it in the data table.

8. Construct a bar graph to show the results.

C. Activity – Part Two

1. Choose at least three of the shapes tested in Part One. For each shape chosen, measure and cut out another 3 to 5 plastic bag pieces of the same shape, but make each piece a different surface area. Record the area for each piece.

2. Again cut 4 pieces of string of the same length for each parachute, fastening them equidistant along the edge of each canopy with the labels or tape

3. Gather the loose ends of each parachute and tie or fasten together with a loop.

4. Attach a large metal paper clip to each of the loops.

5. Drop each finished parachute from the same height as you did in part one. Observe the motion of each parachute as it falls and record its descent time in a data table.

6. Find the average for each shape and surface area and record it in the data table.

7. Prepare a bar graph to display the results. Note: colored pencils will be helpful to distinguish shapes.

D. Wrap-Up

Bring groups together to discuss results as a whole class. Discuss what effect the surface area and the shape of the canopy have on the time of descent of a parachute.

Assessment/Evaluation:

Students will be evaluated on their ability to measure areas of different geometric shapes and their ability to explain the relationships among canopy surface area, canopy shape, and time of descent. The graphs produced should be well organized and easily understood.

Extensions:

1. Make the parachute canopies out of another material such as fabric. Do the results change?

2. Cut a small hole in the top of each parachute. What happens?

3. Try different lengths of string (shrouds). What length seems to work best? What relationship does it have to the surface area of the canopy?

4. Add different weights to the parachutes. How does this affect the time of descent?

Resources/References:

Darling, Dr. David. Experiment! Up, Up, and Away: The Science of Flight. New York: Dillon Press,1991.

Francis, Neil. Super Flyers. Reading, Massachusetts: Addison Wesley Publishing Company, 1988.

Jennings, Terry. How Things Work: Planes, Gliders, Helicopters, and Other Flying Machines. NewYork: Kingfisher Books, 1992.

Scholastic Voyages of Discovery: The Story of Flight. New York: Scholastic Books, 1995.